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THE INFLUENCE OF AN INDIVIDUAL'S COGNITIVE STYLE UPON CONCEPT IDENTIFICATION AT VARYING LEVELS OF COMPLEXITY.

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THIS EXPERIMENT EXAMINED THE EXTENT TO WHICH AN INDIVIDUAL'S COGNITIVE STYLE INFLUENCED HIS PERFORMANCE ON CONCEPT IDENTIFICATION PROBLEMS OF VARYING LEVELS OF COMPLEXITY. COGNITIVE STYLE WAS OPERATIONALLY DEFINED IN TERMS OF AN INDIVIDUAL'S PERFORMANCE ON THE HIDDEN FIGURES TEST (HFT). IT WAS ASSUMED THAT SUBJECTS (SS) ABLE TO IDENTIFY THE HIDDEN FIGURES REPRESENTED AN ANALYTICAL COGNITIVE STYLE, WHILE SS UNABLE TO IDENTIFY THE HIDDEN FIGURES REPRESENTED A GLOBAL OR NONANALYTIC COGNITIVE STYLE. THE HFT WAS ADMINISTERED TO 310 SENIOR HIGH SCHOOL MALES. THE INDEPENDENT VARIABLES WERE TASK COMPLEXITY, COGNITIVE STYLE, AND PROBLEMS. A 3 X 3 X 2 DESIGN WAS FORMED BY FACTORIALLY COMBINING THREE LEVELS OF TASK COMPLEXITY, THREE LEVELS OF COGNITIVE STYLE, AND TWO PROBLEMS. THE RESULTS OF THE ANALYSIS OF VARIANCE ON ERRORS-TO-CRITERION INDICATED THAT THE EFFECT OF COGNITIVE STYLE WAS SIGNIFICANT, AS WERE THE MAIN EFFECTS OF COMPLEXITY AND PROBLEMS. COGNITIVE STYLE WAS FOUND TO INFLUENCE CONCEPT IDENTIFICATION PERFORMANCE. THE HYPOTHESIZED INTERACTION BETWEEN COGNITIVE STYLE AND COMPLEXITY WAS NOT SUPPORTED BY THE DATA. THE AUTHOR BELIEVES THAT THIS FINDING SUGGESTS THAT COGNITIVE STYLE IS RELEVANT WHEN WORKING WITH INDIVIDUALS IN AN INSTRUCTIONAL SITUATION. THIS PAPER WAS PRESENTED AT THE ANNUAL MEETING OF THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION (CHICAGO, FEBRUARY 1968). (IM)

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THE INFLUENCE OF AN INDIVIDUAL'S COGNITIVE STYLE UPON CONCEPT IDENTIFICATION AT VARYING LEVELS OF COMPLEXITY[1]

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Individual difference variables in concept identification have received relatively little attention compared to the consideration given task variables. Bruner, Goodnow, and Austin (1956), for example, observed that individuals differed in the strategies they utilized in identifying concepts but made no attempt to relate these differences to other variables. In extensive reviews of the concept identification literature both Hunt (1962) and Bourne (1966) indicated that the role of individual differences was largely unexplored.

It is well documented that there are large individual differences in the manner in which people perceive and analyze a complex stimulus configuration and that this particular manner or style carries over into other areas of cognitive functioning. Furthermore, there is a growing body of literature which suggests that individual differences in perceptual and conceptual organization are relatively stable and interact to produce consistencies in cognitive functioning. The term cognitive style has been used to refer to individual consistencies in cognitive behavior resulting from the individual's perceptual and conceptual organization of the external environment (Kagan, Moss, & Sigel, 1963).

Data from a number of studies concerned with cognitive style suggest that a person's cognitive style influences his performance in a variety of learning tasks. Fitzgibbons, Goldberger, and Eagle (1965),

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for example, found that recall and recognition of social words incidentally presented was significantly correlated with field dependence. Guetzkow (1951) found that successful performance in problem solving was correlated with successful performance on the Embeded Figures Test. Gardner and Long have demonstrated that many of their cognitive controls were related to serial learning (Gardner & Long, 1960, 1961; Long, 1962).

In the typical concept identification experiment which follows a reception paradigm as outlined by Bourne (1966), the S is presented a series of stimulus patterns which usually vary along several dimensions, such as size, shape and color. The S's task is to learn which dimensions define the concept and which dimensions are irrelevant to the solution of the problem. Thus it can be seen that an ability to analyze a stimulus complex would be critical in solving concept identification problems.

The purpose of this experiment was to examine the extent to which an individual's cognitive style influenced his performance on concept identification problems of varying levels of complexity. Cognitive style was operationally defined in terms of an individual's performance on the Hidden Figures Test (HFT). It was assumed that Ss able to identify the hidden figures represented an analytical cognitive style, while Ss unable to identify the hidden figures represented a global or nonanalytic cognitive style. It was hypothesized that individuals experiencing difficulty in locating hidden figures on the HFT would also experience difficulty in identifying concepts and that these Ss would experience greater difficulty with the more complex concepts.

METHOD

Subjects

The HFT was administered to 310 senior high school males. Of the 310 students tested, three main groups of 30 each were selected for the experiment proper. One group, the high analytic scorers, consisted of Ss who experienced little difficulty on the HFT. Another group, the low analytic scorers, consisted of Ss who experienced great difficulty on the HFT. The third group, middle analytic scorers, consisted of Ss having scores on the HFT which were intermediate in their test performance.

Experimental Materials and Procedure

The stimulus materials utilized in the experiment represented combinations of values from each of seven stimulus dimensions. The dimensions and their corresponding values were: letter (H or L), number of letters (1 or 2), size of letters (large or small), colors of letters (red or green), orientation of letters (upright or tilted), horizontal position of letters (left or right), and vertical position of letters (upper or lower). The total number of unique stimulus patterns was 128, since each pattern represented only one value from each of the seven dimensions. These patterns served as a population from which the three levels of complexity and the two problems utilized in the experiment were constructed.

Two problems which differed only in terms of the two relevant dimensions were used in the present experiment. Complexity was defined in terms of the number of bits of irrelevant information contained within a problem. The three complexity levels were determined by designating one, three or five dimensions as irrelevant. Within a problem and across the three complexity levels, the same two dimensions were relevant. In the 1-bit condition there were three dimensions which varied -- the two relevant dimensions and one irrelevant dimension. In the 3-bit condition there were five dimensions which varied -- the two relevant dimensions and three irrelevant dimensions. In the 5-bit condition all seven dimensions varied -- two relevant dimensions and five irrelevant dimensions.

During the experiment the S was presented a series of stimulus patterns which corresponded to one of three complexity levels which was within the limits of one of the two basic problems. The S's task was to learn to correctly categorize the stimulus patterns into one of four categories, each category representing one of four possible combinations of values from the two relevant dimensions. Each stimulus pattern corresponded to one and only one of the four categories.

The stimulus patterns were projected onto a screen and the S was required to press one of four response buttons in order to determine the category to which a given pattern belonged. If the response was correct, a feedback light was turned on above that response button. If the response was incorrect a feedback light would indicate the correct response to the S. The significance of each button, therefore, was determined by trial and error. The S proceeded until he reached a criterion of 16 consecutively correct responses.

Experimental Design

The independent variables given consideration in the present experiment were task complexity, cognitive style and problems. Three levels of task complexity (1, 3, and 5 bits of irrelevant information), three levels of cognitive style (high analytic, middle analytic and low analytic), and two problems (differing with respect to the two relevant dimensions) were factorially combined to form a 3 X 3 X 2 design. Five Ss from each of the three levels of cognitive style were randomly assigned to the problem by complexity treatment conditions.

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RESULTS AND DISCUSSION

The results of the analysis of variance on errors-to-criterion indicated that the main effect of cognitive style was significant ($F_{(2,72)} = 9.51$; $p < .01$), as were the main effects of complexity ($F_{(2,72)} = 18.31$; $p < .01$), and problems ($F_{(1,72)} = 20.73$; $p < .01$). Also, two interactions were significant -- cognitive style by problem ($F_{(2,72)} = 4.94$; $p < .01$) and complexity by problem ($F_{(2,72)} = 5.82$; $p < .01$).

Table 1 presents the mean errors-to-criterion for cognitive style and problems. The significant main effect of problems merely indicates that performance is dependent upon the particular dimension relevant to problem solution. Subjects solving problem B (size and horizontal position) committed fewer errors than *Ss* solving problem A (letter and letter orientation).

Table 1

Mean Errors-to-Criterion as a Function of Cognitive Style and Problems

	Cognitive Style			
Problems	High	Middle	Low	Mean
A	31.60	50.00	86.60	56.07
B	25.13	26.13	33.67	28.31
Mean	28.37	38.07	60.13	

Subsequent analysis of the cognitive style by problem interaction involved mean comparisons between cognitive style levels for each problem separately. For problem A, the *F* test between cognitive style means was

significant ($F_{(2,72)} = 8.57$; $p < .01$). Furthermore, it was found that high analytic Ss and middle analytic Ss differed significantly from the low analytic Ss ($t = 5.21$ and $t = 3.46$, respectively; $df = 72$; $p < .01$), but that the middle and high analytic Ss did not differ significantly from one another ($t = 1.74$). For problem B, the F test between cognitive style means was not significant ($F < 1$). Thus, it may be concluded that an individual's cognitive style significantly influences concept identification, but only when the conditions employed for problem A are met. These findings further support the observations of Baggaley (1955) who found that analytic Ss were more successful than nonanalytic Ss in a concept sorting task. Similar findings have been reported by Ohnmacht (1966), Elkind, Koegler & Go (1963), and Lee, Kagan and Rabson (1963).

Table 2 presents the mean errors-to-criterion for complexity and problems. The significant main effect of complexity indicated that performance was an increasing function of the complexity of the concept identification problems. An orthogonal polynomial analysis applied to this function indicated that the linear component of variation was significant ($F_{1,72} = 36.33$; $p < .01$). These findings are consistent with the results of Archer, Bourne and Brown (1955), Bourne (1957), and Bourne and Haygood (1960).

Table 2

Mean Errors-to-Criterion as a Function of
Complexity and Problems

	Complexity			
Problems	1	3	5	Mean
A	22.20	53.33	92.67	56.07
B	19.53	26.33	39.07	28.31
Mean	20.87	39.83	65.87	

As can be seen in Table 2, the number of errors-to-criterion for both problems increases linearly with increases in complexity. The rate of increase for problem A, however, was greater than that for problem B. Subsequent analysis of this interaction involved an orthogonal polynomial analysis and indicated that the linear component was significant ($F_{(1,72)} = 11.63$; $p < .01$). Thus, the interaction resulted from differences between the linear trends of the two problems.

In summary, an individual's cognitive style was found to influence his concept identification performance. Individuals identified as analytical on the HFT experienced little difficulty in identifying concepts while Ss (low analytic) who experienced difficulty in locating the simple figure in the HFT experienced considerable difficulty in concept identification. Individuals falling in the middle of the HFT distribution performed at an intermediate level of performance on the concept identification task. The hypothesized interaction between cognitive style and complexity was not supported by the data.

In conclusion, this study demonstrated that cognitive style is an important individual difference variable which exerts a marked degree of influence in concept identification. The relevance of this finding to education is important in view of the current emphasis given to individualized instruction (Klausmeier & Goodwin, 1966). This finding would suggest that cognitive style is relevant when working with individuals in an instructional situation. It would follow that non-analytic students would require assistance in differentiating a stimulus complex to a greater extent than would the high analytic child. Certainly further consideration should be given to the individual difference variable of cognitive style both at empirical and theoretical levels.

REFERENCES

Archer, E. J., Bourne, L. E., Jr., & Brown, F. G. Concept identification as a function of irrelevant information and instructions. Journal of Experimental Psychology, 1955, 49, 153-164.

Baggaley, A. R. Concept formation and its relation to cognitive variables. Journal of General Psychology, 1955, 52, 297-306.

Bourne, L. E., Jr. Effects of delay of information feedback and task complexity on the identification of concepts. Journal of Experimental Psychology, 1957, 54, 201-207.

Bourne, L. E., Jr. Human conceptual behavior. Boston: Allyn & Bacon, 1966.

Bourne, L. E., Jr., & Haygood, R. C. Effects of intermittent reinforcement of an irrelevant dimension and task complexity upon concept identification. Journal of Experimental Psychology, 1960, 60, 371-375.

Bruner, J. S., Goodnow, J. J., & Austin, G. A. A study of thinking. New York: Wiley, 1956.

Elkind, D., Koegler, R. R., & Go, E. Field independence and concept formation. Perceptual and Motor Skills, 1963, 17, 383-386.

Fitzgibbons, D., Goldberger, L., & Eagle, M. Field dependence and memory for incidental material. Perceptual and Motor Skills, 1965, 21, 743-749.

Gardner, R. W., & Long, R. I. Leveling-sharpening and serial learning. Perceptual and Motor Skills, 1960, 10, 179-185.

Gardner, R. W., & Long, R. I. Field articulation in recall. Psychological Record, 1961, 11, 305-310.

Guetzkow, H. An analysis of the operation of set in problem-solving behavior. Journal of General Psychology, 1951, 45, 219-244.

Hunt, E. B. Concept learning: An information processing problem. New York: Wiley, 1962.

Kagan, J., Moss, H. A., & Sigel, I. E. Psychological significance of styles of conceptualization. Monographs of the Society for Research in Child Development, 1963, 28 (2, Whole No. 86), 73-112.

Klausmeier, H. J., & Goodwin, W. Learning and human abilities. (2nd ed.) New York: Harper & Row, 1966.

Lee, L. C., Kagan, J., & Rabson, A. Influence of a preference for analytic categorization upon concept acquisition. Child Development, 1963, 34, 433-442.

Long, R. I. Field-articulation as a factor in verbal learning and recall. Perceptual and Motor Skills, 1962, 15, 151-158.

Ohnmacht, F. W. Effects of field independence and dogmatism on reversal and nonreversal shifts in concept formation. Perceptual and Motor Skills, 1966, 22, 491-497.